



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



Publication number : **0 607 032 A1**

## EUROPEAN PATENT APPLICATION

(12)

(21) Application number : 94300212.1

(22) Date of filing : 12.01.94

(51) Int. Cl.<sup>5</sup> : H02K 11/00

(30) Priority : 14.01.93 JP 672/93

(43) Date of publication of application :  
20.07.94 Bulletin 94/29

(84) Designated Contracting States :  
DE FR GB IT

(71) Applicant : MABUCHI MOTOR KABUSHIKI  
KAISHA  
No. 430, Matsuhidai  
Matsudo-shi, Chiba-ken (JP)

(72) Inventor : Shibata, Hisashi, c/o Mabuchi Motor  
K.K.  
No.280 Ryufukuji,  
Motono-son  
Inba-gun, Chiba-ken (JP)  
Inventor : Egawa, Yoshiaki, c/o Mabuchi Motor  
K.K.  
No.280 Ryufukuji,  
Motono-son  
Inba-gun, Chiba-ken (JP)  
Inventor : Sasaki, Norihiro, c/o Mabuchi Motor  
K.K.  
No.280 Ryufukuji,  
Motono-son  
Inba-gun, Chiba-ken (JP)

(74) Representative : Hitchcock, Esmond Antony  
Lloyd Wise, Tregear & Co.  
Norman House  
105-109 Strand  
London WC2R 0AE (GB)

(54) Miniature motor.

(57) A miniature motor comprises a tubular housing (31) having a closed end with a permanent magnet (32) fitted therein. A rotor (34) having an armature (35) and a commutator (36) is supported by bearings (37,38) in the housing (31) and an end cap (33) engaging the open end of the housing (31). Supporting brushes (39) mounted in the end cap make sliding contact with the armature (35) and are connected to terminals (41). The end cap (33) is formed with a groove (1) which extends between the terminals (41). An electrically conductive spring (2) and a capacitor (3) is disposed in the groove (1) in contact with each other and with the terminals (41).

FIG. 4

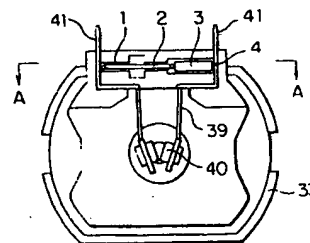
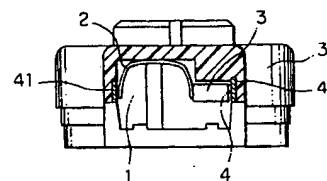


FIG. 5



EP 0 607 032 A1

This invention relates to a miniature motor for use for example, in audio and video equipment, and automotive electrical equipment.

It is known to include in miniature motors components for minimising or preventing the generation of electrical noise. For example, a ground terminal can be used, connecting one of the motor terminals to the motor housing, or a capacitor can be connected between the terminals. These devices take up substantial space either internally or externally of the motor and, particularly where a capacitor is installed, known uses thereof involve relatively complex manufacturing steps.

The present invention is directed at a miniature motor which incorporates a noise reduction mechanism with a small space requirement and which is easy to assemble as part of the motor manufacturing process. Such a motor comprises a tubular housing having a closed end; a permanent magnet fitted in the housing; a rotor having an armature and a commutator; an end cap engaging the open end of the housing, and supporting brushes making sliding contact with the armature and connected to motor terminals; and bearings supporting the rotor for rotation in the housing. According to the invention the end cap is formed with a groove which extends between the terminals, an electrically conductive spring and a capacitor being disposed in the groove in contact with each other and with the terminals. The groove is normally oriented in a plane parallel to the axis of the motor with its open face directed towards the closed end of the motor housing. The capacitor is preferably a chip laminated capacitor, and the spring U-shaped in planar projection, with its plane aligned with that of the groove.

Some examples of prior art motors, and an embodiment of the present invention will now be described by way of example and with reference to the accompanying drawings wherein:

Figure 1 is a partial cross-sectional side view illustrating a known miniature motor construction; Figure 2 is a plan view showing a known electrical noise reduction mechanism applied to a motor of the kind shown in Figure 1;

Figure 3 is a plan view showing another known electrical noise reduction mechanism applied to a motor of the kind shown in Figure 1;

Figure 4 is an inside elevation of an end cap embodying the present invention;

Figure 5 is a sectional view taken on line A-A of Figure 4; and

Figure 6 is an exploded perspective view illustrating the components comprising the end cap shown in Figures 4 and 5.

As shown in Figure 1, a housing 31 made of a metallic material, such as mild steel, is formed into a bottomed hollow tubular shape and has a permanent magnet 32 of an arc-segment shape, for example, fixedly fitted to the inner circumferential surface there-

of. An end cap 33 made of a thermoplastic resin material, for example, is formed in such a fashion as to engage with an open end of the housing 31. A rotor 34 consisting of an armature 35 facing the permanent magnet 32 and a commutator 36, is rotatably supported by bearings 37 and 38 provided on the housing 31 and the end cap 33.

A brush arm 39 made of an electrically conductive material, formed into a strip shape, and having a brush 40 making sliding contact with the commutator 36, is provided inside the end cap 33. The end cap 33 also supports a pair of terminals 41 electrically connected to the brush arms 39 for the transmission of power from an external d-c power source to the armature 35 via the brush arms 39, the brushes 40 and the commutator 36, to actuate the motor in the conventional manner, and drive equipment connected to the rotor 34.

To reduce electrical noise in the motor of Figure 1, the housing 31 may be connected to one terminal 41 via a ground terminal 42 made of an electrical conductive material and formed into a flat sheet shape, as shown in Figure 2. In an alternative arrangement, a capacitor 44 is connected across the terminals 41 via a lead wire 43, as shown in Figure 3.

Other known motor constructions are known from examples of EP-A-509683; GB-A-2172754; GB-A-2173648; and GB-A-2103042.

In the constructions shown in Figures 2 and 3, the ground terminal 42, the capacitor 44 and other component members for reducing electrical noise, require additional space to be provided inside the equipment or system which is driven by the miniature motor. Furthermore, a space larger than necessary may have to be provided because the shape, size and mounting position of the component members for reducing electrical noise are uncertain.

Since the component members for reducing electrical noise are often not interchangeable, separate jigs, tools and personnel have to be provided if multiple types of such members are needed. This lowers production efficiency.

In the construction shown in Figure 3, the operation of connecting the lead wire 43 of the capacitor 44 to the terminal 41 is extremely time-consuming. The soldering operation inevitably needed for wire connections, and the placement and cutting of the lead wires 43 involve a high degree of skills particularly because of the very limited space around the location at which the capacitor 44 is installed. This increases assembly time and manhours, and hence increased manufacturing cost. In addition, soldering in a limited space can result in unstable wire connections, lowering their resistance to vibration or impact during service. This reduces the reliability of the motor.

In the embodiment of the invention shown in Figures 4 and 5 a groove 1 is provided on the inside end

face of the end cap 33. The groove 1 includes a plane parallel to the axial line of the motor, and formed into a flat shape in such a manner to open towards the motor housing 31. The side surfaces of the terminals 41 are brought into contact with the side surfaces of the groove 1.

A spring 2 made of an electrically conductive material, such as copper or a copper alloy, formed into a substantially U shape in planar projection, and fitted into the groove 1 towards one end thereof. A chip laminated capacitor 3 formed into a thin rectangular parallelepiped shape, for example, is fitted into the groove 1 towards the other end thereof. The chip laminated capacitor 3 is thus urged into contact with one terminal 41 by the resiliency of the spring 2, which is itself in contact with the other terminal. In this way, the spring 2 and the chip laminated capacitor 3, form a circuit for reducing electrical noise. Projections 4 are preferably provided on the inside surface of the terminals 41 to ensure electrical connection with the spring 2 and the chip laminated capacitor 3.

Figure 6 illustrates the assembly of the end cap 33 shown in Figures 4 and 5. When the terminals 41 formed into a substantially L shape and connected to the brush arms 39 are forced from the side of the inside end face of the end cap 33 into grooves 5 in the body of the end cap 33, they also traverse the groove 1 such that their side surfaces face each other along the groove 1. When the chip laminated capacitor 3 is inserted into the groove 1 against the positive terminal 41 (right in Figure 6), and the spring 2 is inserted between the capacitor 3 and the negative terminal 41 (left in Figure 6), the elastic force of the spring 2 urges the chip laminated capacitor 3 into engagement with one terminal 41, and the spring 2 itself resiliently engages the other terminal, ensuring electrical connections therebetween. An insulating plate 6 is fitted to a projection 7 provided integrally on the inside end face of the cap 33 to prevent the terminals 41, the chip laminated capacitor 3 and the spring 2 from leaving the groove 1 and short-circuiting with the housing 31.

This invention as illustrated in the foregoing description offers the following benefits:

- (1) By fitting the capacitor between the terminals, electrical noise can be reduced, and the performance of miniature motors can be improved.
- (2) Since the capacitor is incorporated within the body of the end cap, no excess space is needed outside the miniature motor, and thus it is possible to reduce the size thereof, and the space requirement therefor.
- (3) Because component members can be easily assembled, manufacturing cost can be reduced and productivity can be improved.
- (4) Since the preferred spring for holding the capacitor can be formed merely by cutting and bending wire, fabrication cost is low.

## Claims

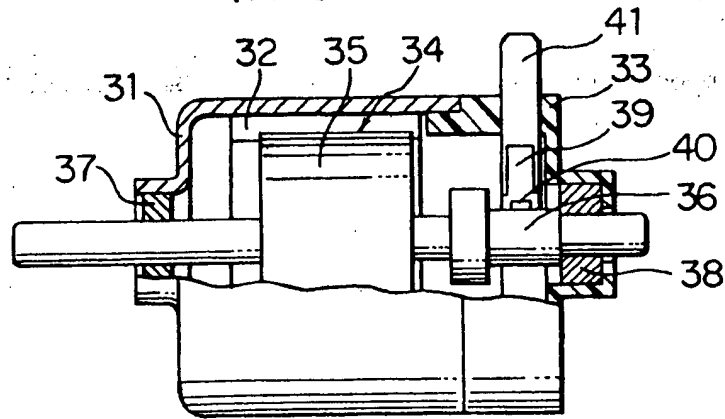
1. A miniature motor comprising a tubular housing (31) having a closed end; a permanent magnet (32) fitted in the housing (31); a rotor (34) having an armature (35) and a commutator (36); an end cap (33) engaging the open end of the housing (31), and supporting brushes (39) making sliding contact with the armature (35) and connected to motor terminals (41); and bearings (37, 38) supporting the rotor (34) for rotation in the housing (31)

### CHARACTERISED IN THAT

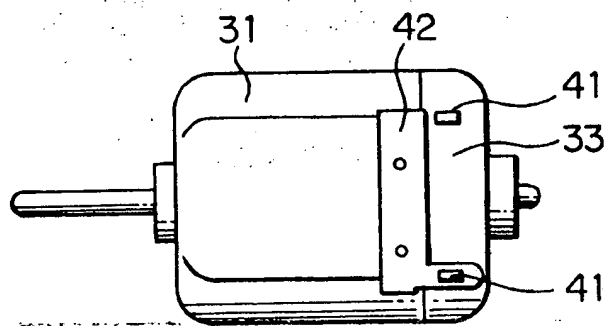
the end cap (33) is formed with a groove (1) which extends between the terminals (41), an electrically conductive spring (2) and a capacitor (3) being disposed in the groove (1) in contact with each other and with the terminals (41).

2. A miniature motor according to Claim 1 wherein the groove (1) is oriented in a plane parallel to the axis of the motor with its open face directed towards the closed end of the motor housing (31).
3. A miniature motor according to Claim 1 or Claim 2 wherein the capacitor (3) is a chip laminated capacitor.
4. A miniature motor according to any preceding Claim wherein the spring is U-shaped in planar projection, with its plane aligned with that of the groove (1).
5. A miniature motor according to any preceding Claim wherein the terminals (41) have projections (4) on their surfaces in contact with the spring (2) and capacitor (3).
6. A miniature motor according to any preceding Claim including an insulating plate (6) closing the open face of the groove (1), and fitted on a projection (7) on the inside end face of the end cap (33).

**FIG. 1**  
(PRIOR ART)



**FIG. 2**  
(PRIOR ART)



**FIG. 3**  
(PRIOR ART)

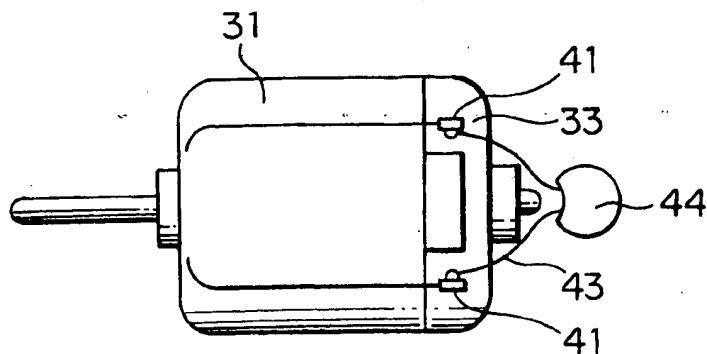


FIG. 4

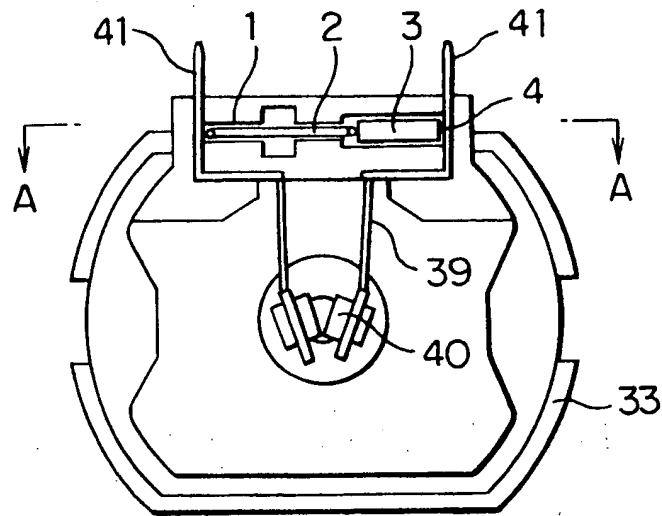


FIG. 5

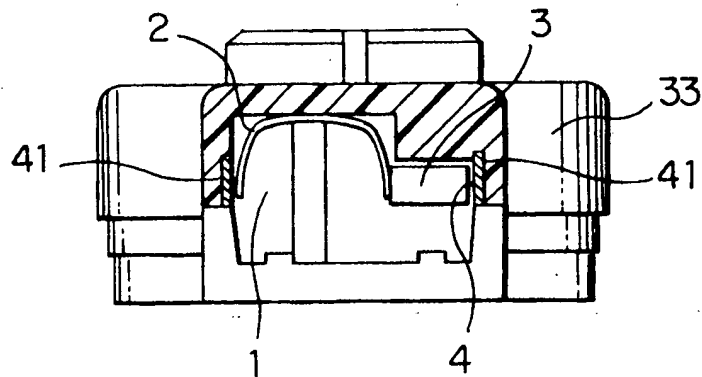
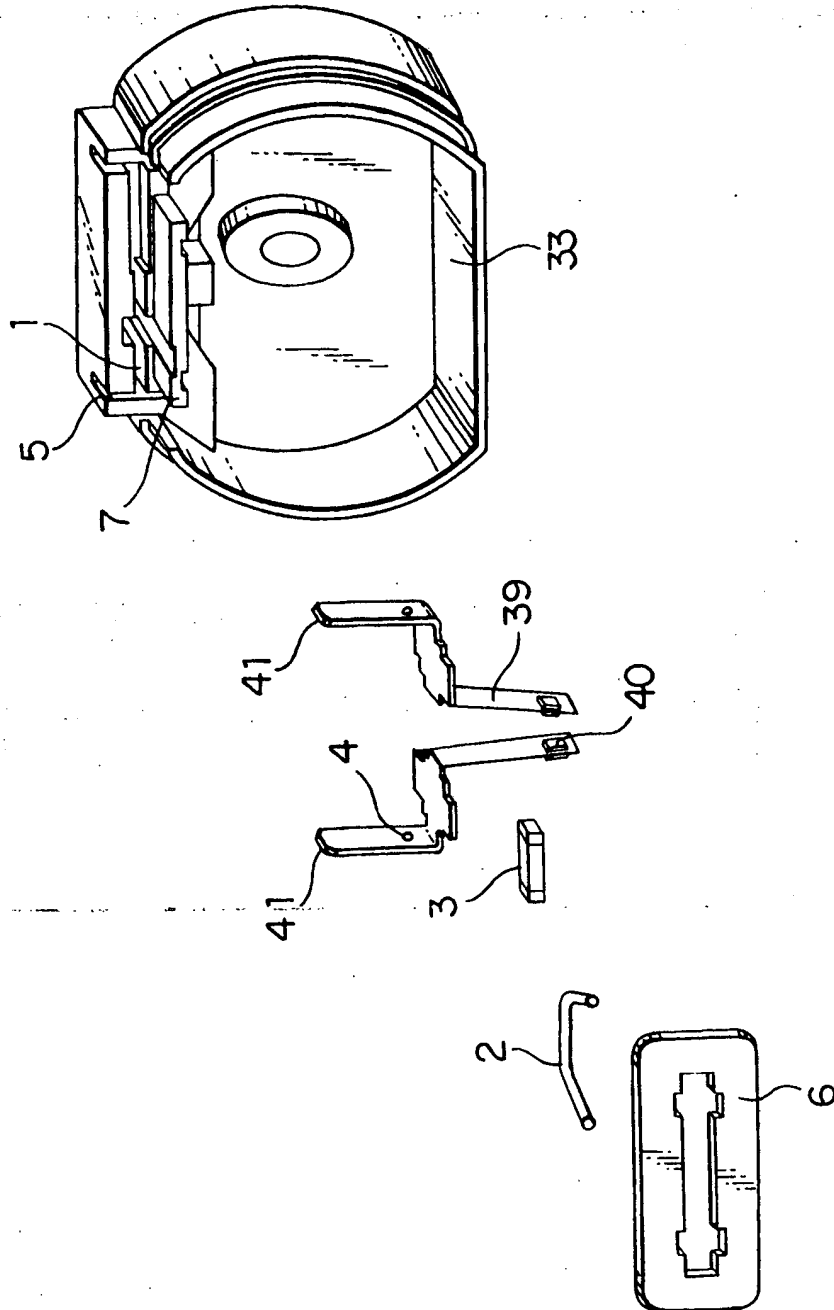


FIG. 6





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 94 30 0212

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
Y	GB-A-2 222 730 (MABUCHI) * page 9, line 23 - page 11, line 12; figures 5-7 *	1,2,4,5	H02K11/00
Y,D	EP-A-0 509 683 (MABUCHI) * the whole document *	1,2,4,5	
A	US-A-4 571 561 (FUJIKI ET AL.) * column 2, line 45 - line 62; figures 4,5 *	3	
A	US-A-3 048 722 (BARON)	6	
The present search report has been drawn up for all claims			<b>TECHNICAL FIELDS SEARCHED (Int.Cl.5)</b> H02K
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>24 February 1994</b>	Examiner <b>Zanichelli, F</b>
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 01.82 (P04C01)